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Bell et al.

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Commissioner for Patents
P.O. Box 1450
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DECLARATION OF SYLVAIN DENNIEL UNDER RULE 132

Sir:

Sylvain Denniel declares:

Since January 1997, I have been employed by Coflexip Stena Offshore Ltd., having an office and place of business in Aberdeen, Scotland. In 2003, Coflexip our head company was merged into Technip. S.A. and I am an employee of Technip UK Limited which is a subsidiary of Technip S.A. as well as Technip France S.A another subsidiary of the group.

I am one of the two authors of an article entitled "Innovations Key Reeled Pipe-in-Pipe Flowline" which appeared in the Oil & Gas Journal of August 13, 2001. As the article notes, it was prepared by Gordon Tough and me, based on a Presentation that Coflexip had made to the Offshore Technology Commerce held in Houston, Texas April 30 - May 3, 2001. My educational background and employment history with CSO, that is Coflexip, since January 1997 appears at page 52 of the article. I am still employed by Technip UK Ltd.

The subject of the article is a pipe-in-pipe or double walled pipeline system that was installed in British Petroleum's Nile field located in the Gulf of Mexico off the shore of Texas and Louisiana. Coflexip supplied the pipe installed in the Nile field. It was one of my duties at the time of the installation of the pipeline to demonstrate the integrity and

performance of the Nile field pipe-in-pipe, through a programme of full scale qualification tests. In my position at the time, I observed the pipeline as described in the article, and in particular observed the pipeline as illustrated in the photograph figures in the article. Figure 8 in particular concerns the water stops which seal the annular space between the inner pipe and the outer pipe. Unfortunately, in the only copy of the article we have available, Figure 8 is obscured by the photocopying process. But, I and my co-author worked with and understood the water stops and provided the description of the water stops in that article, particularly the description at pages 50 and 51.

I was aware of the design, construction and assembly of the Nile pipeline as part of my duties, was familiar then with the Nile pipeline in general and with the water stops in the pipeline in particular and I reported in the article about relevant features of the Nile pipeline of which I was then aware. I today remember the water stops on which I report in this Declaration.

The Nile pipeline is what is referred to in the industry as a pipe-in-pipe pipeline which is double walled. It includes an inner pipe through which a hydrocarbon, typically natural gas but possibly also crude oil, can flow from a well head to a transfer point to a carrier. As the hydrocarbon emerging from beneath the sea floor is much warmer than the water surrounding the pipeline deep under the surface of the Gulf of Mexico, the annular space between the inner pipe and the outer pipe is provided with insulation material in order to retain heat in the hydrocarbon and to prevent premature cooling of the hydrocarbon, which could slow its passage through the inner pipe and possibly cause precipitation out and deposition in the pipe of paraffin and solidified "materials". The outer pipe of the pipe in pipe pipeline aims at protecting the insulation material from ingress of water which would destroy the effectiveness of that insulation material. For assembly reasons, an annular space remains between the insulation layer and the inner wall of the outer pipe. However, that annular space was intended to be dry. Further, it was never contemplated that the annular space would be used for or be capable of transmitting gas longitudinally along the annular space.

Over a standard period of use, the Nile pipeline, like any subsea flow line, might be damaged at the outer pipe or a water leak might develop, and water could then enter the annular space through the outer pipe. If the water migration along the annular space

remained unchecked, the water would eventually destroy the effectiveness of the insulation layer, not just at the area of the leak but over a substantial length of the pipeline. To limit such damage to the insulation to a short length of the inner pipe, it was conventional to supply longitudinally spaced apart water stops in the annular space.

Various design water stops are known. The types of water stops of which I had been aware prior to assembly of the Nile pipeline and prior to the 2001 Houston Conference were water stops that when installed in the annular space, were ready to block flow of sea water along the annular space past the water stop. Therefore, the water stops sealed the annular space and were sealed between the outer surface of the inner pipe and the inner surface of the outer pipe. The Nile pipeline had such water stops.

As the article describes, the water stops of the Nile pipeline used the lip seal concept. Each water stop had an annular shape, with a narrower diameter end which was secured to the inner pipe so it would not move along the inner pipe when sea water impinged on it and which extended toward the direction from which the water to be stopped would flow. It had lips or a free end which would normally be self-biased against the inner surface of the outer pipe. The material of the water stops always was biased outwardly so that its lips always touched the outer pipe. In order to accommodate expected relative axial movement between the outer pipe and the inner pipe, onto which the waterstop is mounted, the force exerted by the lip of the water stop onto the inner surface of the outer pipe was sufficient to seal the annular space against gas flow, but not detrimentally high to prevent relative slippage and damage the lips of the water stop consequently. Relative axial movement is expected to be encountered at the assembly, offshore installation and operational stages of the pipeline's design life.

Upon the occurrence of leakage into one section of the outer pipe between two water stops and especially if the leakage was rapid and under the high pressure at the bottom of the Gulf of Mexico, as soon as the leakage water would contact the water stop, there could be a sudden, possibly massive increase of pressure on the water stops and as the article states, then

> ...the seal is energized if the annulus becomes flooded. When pressure is applied, the water-stop lips are forced into the annulus walls, creating a seal.

Hence, while the seal was always in place and would block gas flow, the purpose of the seal of the water stops was to stop the water and so the seal became energized to stop the water flow caused by the presence of the leakage water under hydrostatic pressure in the annular space. As the same text continues:

> The reason for selecting this concept is that the seal is not energized until required, ensuring that the seal exists in an unstressed state until activated by a flooded annulus.

The seal was present. The lips of the seal were pressing against the inside of the outer pipe. But, the seal was not energized or stressed until required, that is, when the water contacted the seal.

It is apparent that, if the lip seal of the water stops was not in initial contact with the interior of the outer pipe, and if there was a gap between the seal and the outer pipe, through which gas or liquid could flow, that, when a leakage flow started or when water entered the annular space, the water would have a free passage through the preexisting gap between the lips of the water stops and the outer pipe, and there might be insufficient pressure on the water stops seal to energize the water stops to seal the annular space, meaning that water would flow past the water stop and that the purpose of the water stops would be defeated.

In summary, as a person who has been involved in subsea pipelines and pipe-in-pipe now for many years and in 2001 for several years, I have sufficient personal experience and knowledge and am aware of the knowledge of others in the field of pipeline design, not only persons who worked at Coflexip and work for Technip France, but persons who work for other companies, to believe that it would be apparent to me and to them that the water stops described in my article would extend between the inner pipe and the outer pipe and that they would not include any means that would permit the flow of gas along the annular space and past the water stops as, in my opinion, such persons of skill in this art would recognize that such a gas transmission means would defeat the purpose of the water stops.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the

like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this Declaration, the United States patent application for which this Declaration is being supplied and any patent that issues thereon.

Dated: 29-February-2008

SYLVAIN DENNIEL